

## Accumulating Refrigeration Apparatus

### Field of the invention

This invention relates to accumulation apparatus, and particularly to accumulation apparatus for use in refrigerators or freezers. It is, however, envisaged that the apparatus  
5 may have other uses when it is required to accumulate products in an area for a period of time before the products are required, to be removed, e.g. in a bakery or warehouse where products require heating, cooking or ambient storage.

### Background of the invention

Refrigerator and freezer stations including multiple levels or conveyors have been  
10 used in food processing. A conventional industrial refrigerator works by passing though food products on trays into one or more freezing stations and when the product is completely frozen it is removed from the station or stations. The multiple levels allow different food products to be passed through the station at different speeds so that the freezing time may be altered depending on the food product.

15 In some refrigerators, the products are fed into a freezer or chiller station on trays one by one by a pusher. When one product is pushed into the station it pushes previous products along the length of the station towards the station exit. In order to retrieve the products from the freezer station, it has been necessary to fill the entire length of the conveyor so that the product at one end of the station can be removed. One problem with  
20 this operation of refrigerators and freezers is that if products are not yet prepared to be refrigerated or frozen, then empty trays have been added to the freezer or chiller station in order to force the end tray containing frozen or chilled product from the freezer so that the product may be removed. Therefore the station may be filled with empty trays and have unused space.

25 It would be desirable to provide a refrigerator or freezing station which overcomes or alleviates one or more problems associated with the prior art.

It would also be desirable to provide an accumulation apparatus in which products may be accumulated and, when required, removed from the apparatus without the addition of another product.

### Summary of the invention

5 According to one aspect, the present invention provides an apparatus for accumulating products, such as a refrigeration apparatus, comprising:

at least one station where products are to be accumulated;

the station having an entry for products at one end and an exit for products at an opposite end;

10 infeed means for conveying the products to the station entry;

outfeed means for conveying products away from the station exit; and

moving means for moving products from the station entry into the station and for moving products out of the station at the exit to the outfeed means,

15 wherein the moving means is arranged to move a product into the station without simultaneously moving a product out of the station, so that the station can accumulate the product until the product is required to be removed from the station.

Preferably, a common moving means is provided for moving the products into the station and for moving products out of the station. However, the moving means is preferably operated in such a manner as to move a product out of the station  
20 independently of moving products into the station.

According to another aspect of the invention, there is provided a method for accumulating products in at least one station where products are to be accumulated, the station having an entry for the products at one end and an exit for the products at an opposite end, the method including:

25 conveying the products to the station entry;

moving the products from the station entry into the station;

moving the products out of the station to the station exit; and

conveying the products from the station exit,

wherein the steps of moving the products into is not performed simultaneously with the steps of moving the products out of the station to allow accumulation of the products in the station until the products are required to be removed from the station.

Preferably, the apparatus comprises a plurality of stations, each station having an entry and an exit. The stations are preferably provided on a plurality of different levels.

In one preferred embodiment, the products are carried by trays and the moving means includes tray engagement means for engaging with a part of the trays and drive means for driving the moving means. The trays may comprise wheels or slides to assist in the movement of the trays through the station. Preferably, the trays are mechanically conveyed upon a track or rails and, in a particularly preferred arrangement, a tray carrying product is moved along the station until it contacts or nudges the previous tray loaded in that station.

The tray engagement means is preferably provided on carrying means which extends along the entire length of the station. This enables the moving means to engage a tray at selected or indexed positions along the length of the station. This contrasts with existing refrigerator pushers which only have a limited range of movement and which rely on a full complement of trays, empty or loaded with products, to move frozen products out of the station.

In one preferred embodiment, the carrying means for the tray engagement means comprises a chain or belt conveyor system. In another embodiment, the carrying means may comprise a reciprocating beam system.

Advantageously, a station of refrigeration apparatus according to the present invention is able to store more products as the space taken up by empty trays in the prior art is able to be avoided.

The infeed means may comprise an infeed conveyor for accumulating products and conveying the products to the refrigerator, and a pusher for transferring a plurality of products onto a tray. The apparatus may also include an infeed elevator for moving the trays to one of a plurality of stations at different levels.

5           The refrigerator may also include an outfeed elevator and an outfeed conveyor. The outfeed elevator moves the trays from the stations at different levels to the outfeed conveyor. An outfeed pusher may also be included in the refrigerator for moving the product from the trays onto the outfeed conveyor which carries the frozen product away from the refrigerator.

10           Additionally, the refrigerator may also include tray accumulation and return means for removing trays from the outfeed elevator, storing the trays until they are required to be used again, and feeding empty trays to the infeed elevator.

15           A controller is preferably provided for controlling operation of at least one of the moving means, the infeed and outfeed elevators, the infeed and outfeed conveyors and the tray accumulation and return means. Preferably, the controller is arranged to control movement of two or more of the different parts of the apparatus simultaneously.

### **Brief description of the drawings**

Figure 1 shows a schematic side view of an accumulating refrigerator according to a preferred embodiment of the present invention;

20           Figure 2 is a fragmentary top plan view of the accumulating refrigerator of Figure 1;

Figure 3 is a side view of the refrigerator of Figure 2;

Figure 4 is an enlarged detail of Figure 3 showing the infeed means and part of the tray return arrangement;

25           Figure 5 is an enlarged detail of Figure 3 showing the tray unloading arrangement;

Figure 6 is an enlarged detail of Figure 3 showing another part of the tray return arrangement;

Figure 7 is an end view of the refrigerator;

Figure 8 is a plan view of a tray for use in the refrigerator;

5      Figure 9 is a side view of the tray of Figure 8;

Figure 10 is an enlarged end view of the tray of Figure 8;

Figure 11 is a side view of part of the tray return arrangement for loading a tray onto the infeed elevator;

10      Figure 12 is a side view of another part of the tray accumulation and return arrangement;

Figure 13 is a plan view of an alternative arrangement for moving trays with product into and out of the stations of the refrigerator;

Figure 14 is a side view of a spring-loaded latch member forming part of the arrangement of Figure 12 in a first position;

15      Figure 15 is a side view of the latch member of Figure 14 in a second position;

Figure 16 is an end view of the latch member of Figures 14 and 15;

Figure 17 is a side view of the latch member engaging a tray for loading into a station of the refrigerator;

Figure 18 is a side view of a first tray loaded into the station;

20      Figure 19 is a side view of a second tray for loading into the station; and

Figure 20 is a side view showing the second tray loaded into the station.

### Detailed description of the embodiments

Referring to the drawings there is generally shown a refrigerator 1 in accordance with the present invention. The refrigerator 1 includes a plurality of freezing or chilling stations 2 at different levels, infeed means, including an infeed conveyor 3 and an infeed elevator 4, outfeed means in the form of outfeed elevator 5 and outfeed conveyor 6, and moving means shown generally by 7 for moving products into and out of the freezing or chilling stations.

The products 10 are moved through the freezing or chilling stations 2 on trays 8. As shown in Figure 1, there are 16 levels of freezing or chilling stations, but it will be appreciated that the number of freezing or chilling stations may vary depending upon the space available and different requirements. Each station 2 includes an entry 9 for products 10 to be frozen or chilled moved into the station 2 from the infeed elevator, and an exit 11, opposite the entry, through which frozen or chilled products 10 are moved out of the station onto the outfeed elevator. The refrigerator 1 further includes air cooling units 12 which are arranged to blow cold air through the cooling stations in the opposite direction to the direction of movement of products. The refrigerator 1 further includes a tray accumulation and return arrangement shown generally at 13.

One preferred form of moving means for transferring trays 5 into and along the length of the station is shown in more detail in Figure 2. Figure 2 shows a station 2, the infeed conveyor 3 and infeed elevator 4, the moving means 7, the outfeed elevator 5 and outfeed conveyor 6.

Each freezing or chilling station 2 has rails 20 along which the trays 8 are movable. The trays 8 may be provided with rear and front wheels 81, 82 for engagement with the rails 20. Alternatively, the trays 8 may be arranged to slide along the rails 20.

As shown in Figures 2 and 8-10, each tray 8 is of elongate rectangular form having a base 83, end walls 84 and open front and rear sides 85, 86 which enable cartons of product to be pushed onto and off the trays. Each tray 8 also has fingers 18 extending outwardly from each end wall 84 of the tray. The moving means shown in Fig. 2

comprises a pair of chain or belt conveyors 30 extending along opposite sides of the freezing or chilling station 2. Each conveyor 30 has an endless chain or belt 32 extending around a drive wheel 34 at one end and a take up wheel 36 at the other end. Each chain or belt 32 has tray engagement means in the form of a protruding member 38 which protrudes from the side of the chain or belt 32 in such a manner as to be engageable with a finger 18 on the end of a tray 8. Thus, when the chains or belts 32 on both sides of the station 2 are rotating, the protruding members 38 can engage with the fingers 18 of a tray 8 to move the tray 8 into or along the freezing or chilling station 2. The protruding members 38 are preferably hingedly connected to the chains or belts 32, or are connected by a spring loaded or like device, so that they can be moved out of engagement with the fingers 18 of the trays 8 when required. In Fig. 2 part of the freezing or chilling station 2 adjacent the outfeed elevator above the outfeed conveyor 6 has been omitted in order to show the location of the outfeed conveyor 5.

Referring more particularly to Figures 1, 3 and 4, the infeed means includes transfer means in the form of an infeed pusher 14 for pushing cartons of product 10 from the infeed conveyor 3 onto a tray 8 positioned on the infeed elevator 4. The infeed elevator 4 comprises a horizontal platform 42 which is adapted to be raised and lowered by elevating means in the form of a belt or chain 44 which extends around upper and lower pulleys 45, 46.

The outfeed means, shown particularly in Figures 1, 5 and 6 includes transfer means in the form of an outfeed pusher 19 for pushing cartons of product 10 from a tray 8 on the outfeed elevator 5 onto the outfeed conveyor 6. The outfeed elevator 5 also comprises a horizontal platform 52 which is adapted to be raised and lowered by elevating means in the form of a belt or chain 54 extending around upper and lower pulleys 55, 56.

The infeed and outfeed pushers 14, 19 preferably include a pusher head 61 which is reciprocally movable in a substantially horizontal direction to engage with an disengage from the product. The pusher head 61 may be moved reciprocally by any

convenient means such as a piston and cylinder arrangement 62. The pushers may be operated hydraulically or pneumatically or by any other convenient drive mechanism.

Referring particularly to Figures 4, 5 and 6, the tray accumulation and return arrangement 13 includes a tray unloader 70 for unloading tray 8 from the outfeed elevator 5, a tray storage area 72 and a loader 74 for loading tray onto the infeed elevator 4. The tray storage area 72 includes at least one storage rail 76 extending substantially horizontally below the lowermost freezing or chilling station 2. The trays 8 may be stored in the storage area 72 in a horizontal or a vertical orientation. A vertical storage orientation as shown in Figures 4 and 6 is preferred when tray storage space is limited as it enables more trays to be stored on a rail 76. Figures 1 and 6 show two storage rails 76, 77, but it will be appreciated that any number of tray storage rails may be provided to suit the requirements of the refrigeration tunnel.

As shown in Figure 6, the tray unloader 70 includes a first tray pusher 78 for pushing empty trays 8 from the outfeed elevator 5 onto the first storage rail 76 and a second tray pusher 19 for pushing empty trays 8 from the outfeed elevator 5 onto the second storage rails 77. When the trays 8 are to be stored vertically on the storage rails 76, 77, the storage rails 76, 77 may each include a tray inlet rail 79, 80 at a lower level than the respective storage rail 76, 77, and a tray pick-up arrangement 84 for moving the trays 8 from a horizontal orientation on the tray inlet rails 79, 80 to a vertical orientation on the main parts of the storage rails 76, 77.

The tray pick-up arrangement 84 for each storage rail 76, 77 includes a pair of hydraulic rams 85 each mounted on one end of a respective crank arm 86. The other ends of the crank arms 86 are mounted on opposite ends of a torsion rod or tube 88 for pivotal movement about a pivotal axis. The hydraulic rams 85 are actuated to engage the front or leading wheels 82 of trays 8 in a horizontal orientation on the tray inlet rails 79, 80, and the crank arms 86 pivot about the axis of the torsion rod or tube 88 to move the trays to the vertical orientation on the main parts of the storage rails 76, 77. In this position, the trays 8 are suspended from the main parts of the storage rails 76, 77 with the trays being supported only by their front wheels 82 and the rear or trailing wheels 81 hanging below



the storage rails 76, 77. A hydraulic motor and gearbox 89 may be provided at one end of the torsion tube 88 for rotating the torsion tube 88 to achieve the pivotal movement of the crank arms 86.

5 When the trays 8 are stored vertically on the storage rails 76, 77, a pick-up arrangement 90 is required in order to move a tray 8 at the infeed end of the storage rail 76, 77 from its vertical orientation into a horizontal orientation for placement on the infeed elevator 4 as shown in Figure 4.

10 The pick-up arrangement 90 is shown in more detail in Figure 11 and includes a first pair of hydraulic rams 91 each actuatable to engage a forward part 92 of a respective side of the tray 8, and a second pair of hydraulic rams 93 each actuatable to engage an intermediate part 94 of a respective side of the tray 8.

15 The hydraulic rams 91, 93 at each side of the tray 8 are mounted on respective crank arms 96. The first pair of rams 91 being provided at one end of the crank arms 96. The other ends of the crank arms are mounted on opposite ends of a torsion rod or tube 98 for pivotal movement about the axis of the torsion tube 98. The second pair of hydraulic rams 93 are provided at intermediate positions along the crank arms 96.

20 In operation the hydraulic rams 91, 93 are actuated to engage the forward and intermediate parts 92, 94 of the sides of a tray 8 suspended vertically at the infeed end of a storage rail 76, 77 as shown in Figure 4. The crank arms 96 are then pivoted about the axis of the torsion tube 98 to move the tray 8 from its vertical orientation on the storage rail 76, 77 to a horizontal orientation on the platform 42 of the infeed elevator 4. A hydraulic motor and gearbox 99 may be provided at one end of the torsion tube 88 for rotating the torsion tube 98 to achieve the pivotal movement of the crank arms 96.

25 The accumulating refrigerator may also include a controller (not shown), which is arranged to synchronise movement of different parts of the system in order to minimise time delays.

A preferred method of operation of the refrigerator will now be described. In operation, cartons of product 10 to be frozen or chilled are accumulated on the infeed

conveyor 3. When a required number, e.g. ten, cartons have been accumulated alongside the infeed elevator 4, the infeed pusher 14 transfers the cartons of product 10 onto a tray 8 placed on the infeed elevator. The freezing or chilling station 2 in which the tray 8 is to be stored is selected via the controller and the tray 8 is transported to the station 2 via the infeed elevator 4.

When the infeed elevator 4 has reached the selected freezing or chilling station 2, the controller activates the moving means 7 to move the tray 8 into the station 2. This is achieved by operating the chain or belt conveyors 30, so that the protruding members 38 on the moving chain or belt 32 engage the outwardly extending fingers 18 on the ends of the tray 8 to move the tray with product 10 to be frozen or chilled into the station 2. If the cartons of product are the first ones inserted into the station 2, the controller preferably controls the moving means 7 so that the tray 8 is stopped at an end location in the station 2 (indicated by A in Fig. 1). The protruding members 38 are then retracted out of engagement with the fingers 18. This may be achieved either by placing the chain or belt conveyors 30 in reverse, or by moving the protruding members 38 inwardly about a hinged connection or spring loaded or like device.

Preferably, while the tray 8 is being moved towards the station exit 11 by the moving means 7, the controller operates the infeed elevator 4 to lower the platform 42 to one of the levels of the tray accumulation arrangement, where a tray loader (not shown) is operated by the controller to load a tray 8 on the platform 42. The platform 42 is then moved back to the level of the infeed conveyor 3.

If one or more trays 8 with cartons of product 10 have previously been inserted into the freezing or chilling station 2, but are not yet required to be removed, the tray 8 of product transferred into the freezing or chilling station 2 from the infeed elevator 4 is moved along the rails 20 of the freezing or chilling station 2 until it contacts the tray 8 last transferred into the station 2. Then the protruding members 38 are retracted out of engagement with the fingers 18, e.g. as described above, and the conveyors 30 are operated to move the protruding members 38 back into position ready to engage the next tray 8 of product 10 to be frozen or chilled. Whilst this is happening, the controller is

preferably operating the infeed elevator 4 to move the next tray 8 of product 10 from the infeed level to the freezing or chilling station 2.

5 The process continues until the required number of products 10 to be frozen to fill the freezing or chilling station 2 have been moved on trays 8 and accumulated in the freezing or chilling station 2, or unless the controller determines that products 10 to be frozen or chilled are to be moved into another one of the freezing or chilling stations 2. During this process, the products 10 to be frozen or chilled are accumulated in the freezing or chilling stations 2 without moving products out of exits 11 of the freezing or chilling stations 9.

10 When it is required to remove frozen or chilled products 10 from the freezing or chilling stations 2, the controller moves the outfeed elevator 5 to the required station level and activates the moving means 7 at that level. The protruding members 38 of the chain or belt conveyors 30 are moved into engagement with the last tray 8 inserted into that freezing or chilling station 2 and subsequent movement of the chains or belts 32  
15 causes the trays 8 at that level to advance to move the tray 8 at the exit 11 of the station 2 onto the platform 52 of the outfeed elevator 5. The controller is able to control movement of the chain or belt conveyors 30 in an indexed manner so that the protruding members 38 can be moved in increments, one tray width at a time.

20 The outfeed elevator 5 is then operated by the controller to move the tray 8 with frozen product 10 on its platform 52 to the level of the outfeed conveyor 6. The outfeed pusher 19 is then operated to move the frozen or chilled product 10 from the tray 8 onto the outfeed conveyor 6 which then conveys the frozen or chilled product 10 out of the refrigerator 1. The outfeed elevator 5 is subsequently moved to one of the tray unloading and storage levels where the tray unloader 78, 79 at that level is operated by the controller  
25 to unload the tray 8 from the outfeed elevator 5 and move it onto the appropriate storage rail 76, 77 of the tray accumulation and return arrangement 13.

The outfeed elevator 5 is then moved by the controller to the level of the next frozen or chilled product 10 to be removed. This may be the same level as the freezing or chilling station 2 where the previous frozen or chilled product 10 was removed. In this

case, there is no need to move the chain or belt conveyors 30 at that level because the protruding members 38 are still in engagement with the last tray in the freezing or chilling station at that level. The process described above is then repeated to move the frozen or chilled product on the end tray 8 onto the outfeed elevator 5 and then to the outfeed conveyor 6.

When all trays 8 of frozen or chilled product 10 have been removed from a freezing or chilling station at one level, and/or if it is required to remove frozen or chilled product 10 from a freezing or chilling station 2 at a different level, the outfeed elevator 5, after tray removal, is moved to the level of the next frozen or chilled product 10 to be removed. During the time it takes for the outfeed elevator 5 to move frozen or chilled product 10 to the outfeed conveyor 6, then to the tray unloading level and subsequently to the freezing or chilling station level of the next frozen product 10 to be removed, the controller can operate the moving means 7 to move the chain or belt conveyors 30 at appropriate freezing or chilling station level so that the protruding member 38 of the chain or belt conveyors 30 are ready to engage the fingers 18 of the last tray 8 at that level and then move the end tray 8 with frozen or chilled product 10 onto the platform 52 of the outfeed elevator 5.

It will be appreciated from the description above that by utilizing an indexed moving means which is movable along the entire length of the freezing or chilling station for engaging and moving trays 8 in the station, the operations of moving trays of products into and out of the freezing or chilling station can be separated. Therefore, in contrast to known refrigerators, it is not necessary to move a tray into a freezing or chilling station when it is desired to remove a tray from that freezing or chilling station. This eliminates the requirement to move empty trays into freezing or chilling stations when there is no product to be frozen or chilled available to be moved into the stations and it is required to remove frozen or chilled products from the stations. The use of empty trays to remove frozen or chilled products creates product gaps in the freezing or chilling stations, whereas in the present invention, the accumulating refrigerator is able to accept a full complement of product at all times.

Referring to Figures 13 to 20 there is shown an alternative arrangement 100 for moving trays 8a, 8b into and out of a freezing or chilling station 2. The arrangement 100 includes a pair of reciprocating beams 101, 102 on each side of the station 2. Each beam 101, 102 has tray engaging means in the form of a plurality of spring-loaded latch members 110 at spaced intervals which are engageable with projections 118 extending  
5 outwardly from the sides of each tray 8. Each latch member 110 is pivotally movable between an upright position shown in Figure 15 in which an upper lug 112 on the latch member 110 is engageable with a projection 118 on the side of a tray 8, and an inclined position shown in Figure 14 in which the latch member 110 is moved out of engagement  
10 with the projection 118. A secondary reciprocally movable slide member 120 is associated with each reciprocating beam 101, 102. Each slide member 121, 122 has a latch release element 124 which is adapted to engage with a lower part 114 of the latch member 110 to disengage the latch member 110 against the action of a restoring spring means 116 which normally biases the latch member 110 into its upright position.

15 In operation of the moving arrangement of Figures 13 to 20, a tray 8a for loading into a station 2 is moved by the infeed elevator to a position in which its projections 118a are disposed in front of the upper parts 112 of the latch members 110 disposed on the reciprocating beams 101, 102 alongside the infeed elevator 4. (Figure 17). In this position, the latch release elements 124 on the secondary slide members 121, 122 are in a  
20 retracted position out of engagement with the lower parts 114 of respective latch members 110.

The reciprocating beams 101, 102 are then moved in a forward direction by an amount equal to approximately one tray width to move the tray 8a from the infeed elevator 4 into the freezing or chilling station 2 as shown in Figure 18. The secondary  
25 slide members 121, 122 are then advanced so that the latch release elements 124 disengage the latch members 110. The reciprocating beams 101, 102 can then be moved in the reverse direction by an amount equal to one tray width. This moves the latch members back so that the latch member 110a which was previously in front of the tray 8a in the freezing or chilling station 2 is moved back to the position of tray 8a and the latch  
30 member 110 which previously moved tray 8a into the freezing or chilling station 2 is

5 moved back to its original position at the infeed elevator 4. A second tray 8b can then be moved by the infeed elevator 4 so that its projection 118b are disposed in front of the upper parts 112 of the latch member 110 as shown in Figure 19. The secondary slide members 121, 122 are then retracted to move the latch release members 124, 124a out of engagement with the lower parts 114, 114a of the latch members 110, 110a. Each latch member 110, 110a is then automatically moved by its respective spring means 116, 116a into its upright position.

10 The reciprocating beams 101, 102 are then moved in the forward direction, again by an amount of one tray width so that the tray 8a is advanced by latch member 110a in the freezing or chilling station 2 by an increment of one tray width, and the second tray 8b is moved by latch member 110 from the infeed elevator 4 into the station 2 as shown in Figure 20. The secondary slide members 121, 122 are then advanced so that the latch release members 124, 124a engage the lower parts 114, 114a of the latch members 110, 110a to disengage the latch members. The process can then be repeated to load another  
15 tray into the freezing or chilling station and to advance the trays 8a and 8b by a further step into the station 2.

20 It will be appreciated that the arrangement 100 of Figures 13 to 20 for moving trays 8 into and along a freezing or chilling station 2 may be operated without having to introduce a new tray from the infeed elevator 4 into the station 2. This is achieved by providing a number of latch members 110 at spaced intervals along the reciprocating beams 101, 102 equal to the number of trays that can be received in the station 2. Thus a tray 9 can be moved along the station 2 by the indexed moving arrangement until it reaches the tray previously loaded into the station. Also, when a tray 8 is required to be moved from the outfeed end of the station 2 onto the outfeed elevator 5, the indexed  
25 moving arrangement 100 is able to remove that tray by engagement of the last latch members 110 at the outfeed end of the station 2 with the projections 118 on the sides of the tray 8. Once again, this can be achieved without having to load a fresh tray 8 from the infeed elevator 4 into the station.

Whilst the preferred embodiments have been described in relation to refrigeration apparatus, it should be appreciated that the invention has application to other types of apparatus where it is desired to accumulate products in an area for a period of time before they are required to be removed. For example, dough and bread products could be accumulated in baking stations in a bakery which is supplied with hot air for heating, cooking or baking rather than cold air for freezing or chilling. The invention also has application in other areas, such as warehousing where products are to be stored for a period of time under ambient conditions.

It will be appreciated that various modifications and alternations may be made to the preferred embodiments described above, without departing from the scope and spirit of the present invention. For example, the form of the moving means for moving trays of product into and out of the stations may be varied, as may be the tray accumulation and return arrangement. In another possible embodiment, a reciprocating beam arrangement for moving trays of product into and out of the stations may involve a mechanical latch arm/pawl type system which engages on all trays until the tray approaching the last stationary tray mechanically interrupts the latch and disengages it.